

# Denver Water's 2003 Treated Water Quality Summary Report



View of Downtown Denver from City Park





To order call 303-628-5996,

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## Introduction

Denver Water provides its customers with high quality drinking water. We want you to be aware of how that quality is maintained and to feel comfortable with and be knowledgeable of the water treatment process and the care and effort that go into providing the Denver Metropolitan Area with water that meets the most stringent standards.

We prepared this report to provide you with important information about Denver's water quality. We want you to see why we have confidence in the quality of Denver's drinking water.

## Explanation of Terms

To better understand this report, refer to the table below, it gives explanations of terms and measurement units that are used in the report:

Measurement Units Interpretation Table  
Measurement Units Interpretation Table

Unit	Full Name	Equivalent to:
<i>General Terms</i>		
<b>SU</b>	Standard Units (a measurement of pH)	
<b>µS</b>	Micro Siemens (a measurement of specific conductance)	Micro mhos
<b>°C</b>	Degrees Celsius ( a measurement of temperature)	25°C ≈ (= approx.) 77°F (Fahrenheit)
<i>Chemical Terms</i>		
<b>mg/L</b>	Milligrams per Liter	Parts per million (ppm)
<b>µg/L</b>	Micrograms per Liter	Parts per billion (ppb)
<b>NTU</b>	Nephelometric Turbidity Units (a measurement of turbidity)	
<b>pCi/L</b>	PicoCuries per Liter (a measurement of radioactivity)	50 pCi/L ≈ 4 mRem/yr
<b>mRem/yr</b>	Millirem per year ( a measurement of radioactive dosage)	
<b>AU</b>	Absorbance units (a measurement of the absorbance at a specific wavelength)	
<i>Microbiological Terms</i>		
<b>CFU/100 ml</b>	Colony forming units per 100 milliliters (a bacterial unit)	
<b>Count/ml</b>	Count of organisms per milliliter of sample ( a bacterial unit)	

## Report Data

This report includes graphs and tables summarizing data for samples collected throughout the year 2003 from the potable treated water leaving Denver Water's treatment plants (plant effluents). This report also includes some data from the plant influents (raw water). Results are expressed primarily as averages unless otherwise specified. The data tables that begin on page 18 give the MCL, Maximum Contaminant Level (the highest allowable level for a substance in drinking water), the average (avg.) value, the range of values from the lowest to the highest for the year, and the number of samples tested (no.).

Parameters such as temperature, and turbidity, are measurements of physical characteristics and are expressed in units specific to their analyses. Chemical results are generally expressed in terms of concentration, weight or amount per unit volume, e.g. mg/L or µg/L. Microbiological results are generally expressed in terms of a count of organisms per volume of sample, e.g. CFU/100 ml. For total coliform, the percent of positive samples each month is calculated and reported. The CDPHE (Colorado Department of Public Health and Environment) the primacy agency that enforces the EPA regulations in Colorado states that no more than 5% of the samples may be positive per month.

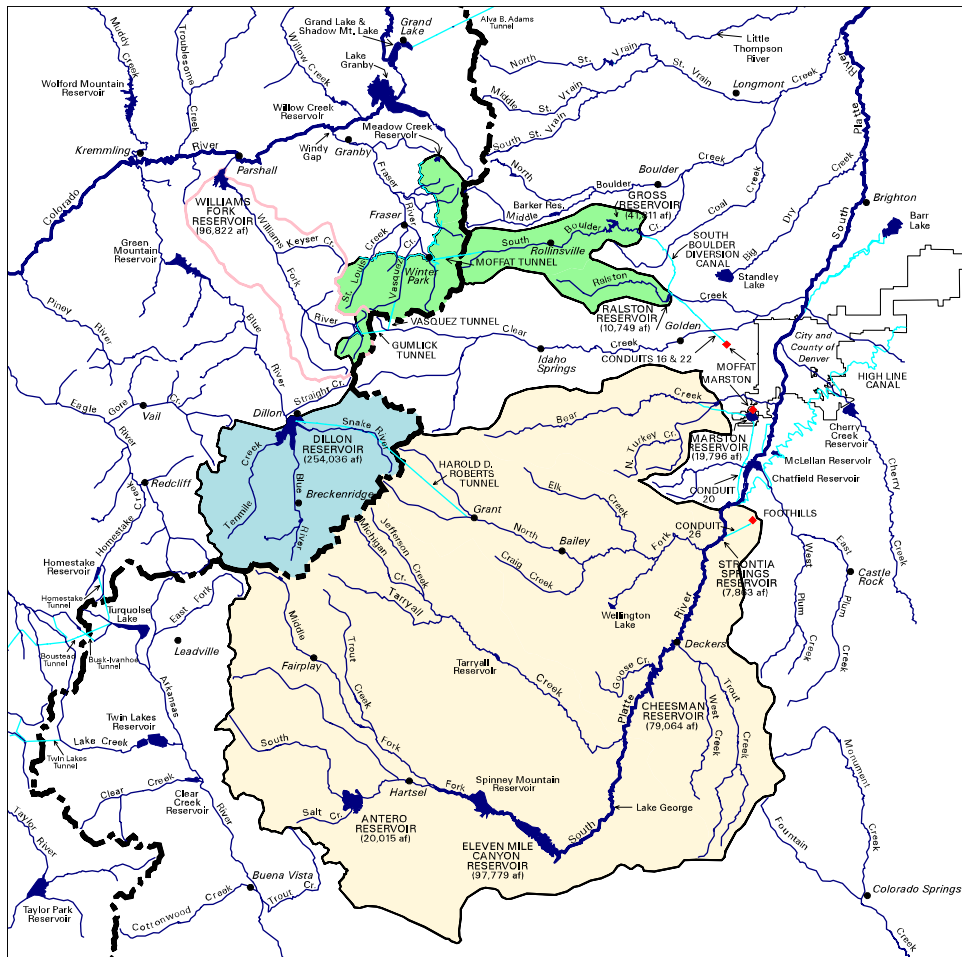
Treatment Plant Effluent and Distribution System  
Total Coliform Samples for 2003

<u>Month</u>	<u>Number of Samples</u>	<u>Number of Positives</u>	<u>% Positive</u>
January	574	0	0.00%
February	495	0	0.00%
March	385	0	0.00%
April	604	1	0.17%
May	509	0	0.00%
June	545	3	0.55%
July	573	2	0.34%
August	535	2	0.37%
September	574	0	0.00%
October	570	1	0.17%
November	404	1	0.25%
December	<u>474</u>	<u>0</u>	<u>0.00%</u>
Totals	6,242	10	0.16%

## Where Does Denver Get Its Water?

The South Platte collection system combines water from high mountain regions on the east slope of the Rocky Mountains with water diverted from Summit County and the Dillon collection system on the west slope of the Continental Divide. The Moffat collection system spans both sides of the Continental Divide, with the majority of it being located in Grand County on the west slope. Raw water from the Moffat collection system is sent through the Moffat Tunnel to facilities northwest of Denver for storage and treatment. Both sources provide high quality water, but their chemical characteristics are quite different and the source water mineral concentration varies seasonally with the amount of flow. In general, the water in the South Platte system is moderately hard (has a higher mineral content) and the water in the Moffat system is soft (has a lower mineral content).

### Water Collection System



#### LEGEND

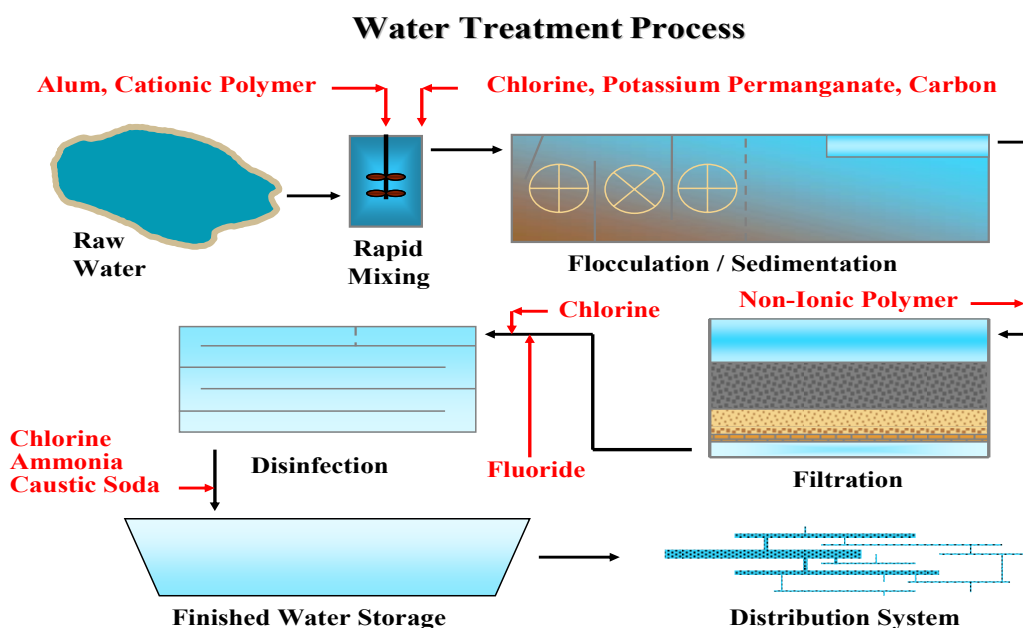
- |  |   |
|--|---|
| <span style="display: inline-block; width: 20px; height: 10px; background-color: yellow; border: 1px solid black;"></span> South Platte Collection System      | <span style="display: inline-block; width: 20px; border-top: 2px solid black;"></span> Continental Divide                                   |
| <span style="display: inline-block; width: 20px; height: 10px; background-color: lightblue; border: 1px solid black;"></span> Roberts Tunnel Collection System | <span style="display: inline-block; width: 20px; border-bottom: 2px solid blue;"></span> Major Stream or River                              |
| <span style="display: inline-block; width: 20px; height: 10px; background-color: lightgreen; border: 1px solid black;"></span> Moffat Collection System        | <span style="display: inline-block; width: 20px; border-bottom: 2px solid cyan;"></span> Major Canal or Tunnel                              |
| <span style="display: inline-block; width: 20px; border-bottom: 2px solid pink;"></span> Williams Fork Reservoir Watershed                                     | <span style="display: inline-block; width: 10px; height: 10px; background-color: blue; border-radius: 50%;"></span> Major Lake or Reservoir |
| <span style="color: red;">♦</span> Denver Water Treatment Plant  | <span style="color: black;">•</span> Town   |

## How Does Denver Make Drinking Water?

Denver Water has three treatment plants that process water collected from the areas shown above. Denver Water's three treatment plants have a combined maximum treatment capacity of 715 million gallons per day. Two treatment plants, Foothills and Marston, process water from the South Platte collection system. The third plant, Moffat treats water from the Moffat collection system.

The treatment process begins with the addition of "coagulants" to the raw water. These coagulants are commonly referred to as Alum and Polymer. Alum is aluminum sulfate a chemical that attracts 'dirt' and other particles in the water. Through a process of slow mixing, the particles collide and stick together to make them larger. The larger particles are called "floc". Polymer strengthens the floc making it easy to filter in later processes. These now larger particles settle to the bottom of the sedimentation basin and the clarified water at the top of the basin is then sent to silica sand filters at Moffat and sand and coal dual media filters for filtration at the other two plants. Filtration removes any of the particles carried over from the sedimentation process. Each treatment plant aims for extreme clarity of the water, evidenced by low turbidities (a measure of clarity). Less than 0.20 turbidity units is a measure of clear, clean water. Potassium Permanganate or Carbon may also be added to control excess manganese or odors, respectively.

After filtration, the water is sometimes supplemented with a small amount of sodium silica fluoride to bring the total concentration of fluoride up to 0.90 mg/L. Caustic soda controls the pH, acidity/alkalinity of the water. It is added to adjust the pH of the water to between 7.5 S.U and 8.0 S.U. Finally, the water is thoroughly disinfected with a solution consisting of chlorine and a small amount of ammonia to form the final disinfectant called "chloramine." Foothills does not have a contact basin as displayed in the schematic below.



## Why Is The Water Treated This Way?

The treatment train outlined above is designed to remove dirt, particulate matter, naturally occurring organic matter (NOM), and microscopic organisms like bacteria that may be in the raw water. Effective filtration is crucial in the removal of microorganisms, including bacteria that are associated with solids such as dirt and debris. Disinfection kills potentially harmful microorganisms. Disinfection of drinking water has saved millions of lives over the century by preventing waterborne diseases such as typhoid and cholera.

Denver Water has used chlorine as a primary disinfectant since 1906. We use it early in the treatment process to allow sufficient contact time with the water for maximum disinfection. We have used chloramine since 1918. It is our secondary disinfectant. Chloramine is a very effective long lasting disinfectant that produces fewer disinfection by-products (DBPs), such as Trihalomethanes (THMs) and Haloacetic Acids (HAAs).



The Environmental Protection Agency (USEPA) establishes the regulations for all water utilities. In Colorado, the state health department (Colorado Department of Public Health and Environment, CDPHE) is the agency that oversees and enforces these regulations for water utilities. These regulations are very strict and require that drinking water is made safe for consumption over a person's lifetime. At present there are over 85 contaminants and groups of contaminants that are regulated in drinking water. Some of these contaminants are clearly a threat, like lead, while others are merely suspected of being health risks, but still considered serious enough to regulate. EPA has set regulatory limits for these compounds. Regulatory limits are levels of safety that must not be exceeded in order to maintain safe drinking water. Some contaminants are regulated based on the possibility of their occurrence in water. Their regulatory limits or levels were determined based on the best available data from health studies. The majority of the EPA's drinking water regulations apply to treatment plant effluent water (the finished water after treatment). We're happy to report that Denver Water has never violated any regulations to date. The compounds and elements that were **not** detected in any of the three treatment plant effluents are listed on page 17.

## How Well Is Denver Water Doing?

Denver Water has been very fortunate to have clean source water with which to start treatment. The table below illustrates the effectiveness of treatment for a few parameters of note.

As mentioned earlier turbidity is a measurement of the clarity of the water; thus a low turbidity indicates good water clarity. Most microorganisms including bacteria are attached to particulate matter, which accounts for much of the turbidity in water. Therefore, turbidity is an extremely important parameter and has been regulated by the EPA for many years. This regulation requires that turbidities in the treatment plant effluent waters be less than 0.30 turbidity units. For the last few years Denver Water has maintained plant effluent turbidities less than 0.20 turbidity units. Most of the time, we have less than 0.10 turbidity units!

Water hardness is relative, but in general, water with hardness above 12 grains per gallon is considered “hard” water. Hardness in water is an aesthetic quality and does not relate to the safety of the water. It relates to the mineral content of the water. When the mineral content of the water is higher, the water is harder. You may have noticed that in areas that have “hard” water, the ability to form soapsuds is lessened. Many customers inquire about the hardness of their water. The South Platte source has moderately hard water that varies seasonally from about 5 to 7 grains per gallon (gpg) of hardness. The Moffat source, on the other hand is very soft, with hardness in the range of about 1 to 4 gpg.

The total coliform test is a measure of all types of coliform bacteria in the water. Coliform bacteria are ubiquitous they are even found in soils and on plants. We test for coliform bacteria, which includes *E. coli*, which is found in the intestines of all mammals, including humans, to determine the cleanliness of the water. We test for total coliform in our plant influent and effluent waters as well as throughout our entire distribution system. On the rare occasion when a sample has tested positive for total coliform, we must then test for *E. coli*, as well as resample and re-test not only the original site, but also up and downstream of it. If *E. coli* is detected in the treated water, public notification would be mandated, and we would isolate and correct the problem.

Average Values for 2003

Parameter	Treatment Plant	Raw Water Result	Finished Water Result
<b>Turbidity</b>	Marston	3.55	0.06
<b>Turbidity</b>	Foothills	6.47	0.05
<b>Turbidity</b>	Moffat	3.48	0.05
<b>Total Coliform</b>	Marston	2224	None detected
<b>Total Coliform</b>	Foothills	435	None detected
<b>Total Coliform</b>	Moffat	89	None detected

## Are There More Serious Contaminants in the Water?

Denver Water has tested for all of the EPA regulated compounds for years and in anticipation of upcoming regulations, has tested for newly identified contaminants as well. Contaminants that have been seen in news headlines include lead, arsenic, mercury, *Cryptosporidium*, *Giardia*, and *E. coli* (*Escherichia Coli*) among others. Denver Water has tested for these for over 16 years and has not detected them in the treated water. *Giardia* and *Cryptosporidium* have occasionally been detected in the raw water, but the effective treatment system in our plants, as outlined on page 7, removes or inactivates these microorganisms.

Denver Water Average Values for 2003

Parameter	Treatment Plant	Raw Water Result	Treated Water Result
<b>Lead</b>	Marston	None Detected	None Detected
<b>Lead</b>	Foothills	None Detected	None Detected
<b>Lead</b>	Moffat	None Detected	None Detected
<b>Arsenic</b>	Marston	None Detected	None Detected
<b>Arsenic</b>	Foothills	None Detected	None Detected
<b>Arsenic</b>	Moffat	None Detected	None Detected
<b>Mercury</b>	Marston	None Detected	None Detected
<b>Mercury</b>	Foothills	None Detected	None Detected
<b>Mercury</b>	Moffat	None Detected	None Detected

Denver Water Average Values for 2003

Parameter	Treatment Plant	Raw Water Result	Treated Water Result
<b><i>Giardia</i></b>	Marston	2	None Detected
<b><i>Giardia</i></b>	Foothills	3	None Detected
<b><i>Giardia</i></b>	Moffat	None Detected	None Detected
<b><i>Cryptosporidium</i></b>	Marston	None Detected	None Detected
<b><i>Cryptosporidium</i></b>	Foothills	None Detected	None Detected
<b><i>Cryptosporidium</i></b>	Moffat	None Detected	None Detected
<b><i>E. Coli</i></b>	Marston	13	None Detected
<b><i>E. Coli</i></b>	Foothills	6	None Detected
<b><i>E. Coli</i></b>	Moffat	4	None Detected

## Minerals In Nature That Are Found In Water



All natural waters contain ‘minerals’ from the earth. These mineral salts result from the natural erosion of soils, rocks and/or the decay of plants. The amounts of these minerals in water also determine the characteristics of the water, such as its hardness. Minerals in water give water its flavor. Mineral-rich water often tastes chalky or strong. Of the minerals shown above only barium and aluminum are regulated. Barium has a MCL (maximum contaminant level) of 2 ppm, while aluminum has a SMCL (secondary MCL), which is a non-enforceable drinking water regulation of 0.05 to 0.2 ppm.

### Denver Water Average Values for 2003

Parameter	Treatment Plant	Raw Water Result	Treated Water Result	EPA Regulatory Limit
<b>Aluminum</b>	Marston	0.089	0.025	0.05—0.2 ppm
<b>Aluminum</b>	Foothills	0.279	0.064	0.05—0.2 ppm
<b>Aluminum</b>	Moffat	0.206	None Detected	0.05—0.2 ppm
<b>Barium</b>	Marston	0.047	0.044	2 ppm
<b>Barium</b>	Foothills	0.048	0.043	2 ppm
<b>Barium</b>	Moffat	0.020	0.018	2 ppm
<b>Calcium</b>	Marston	32.7	32.0	None
<b>Calcium</b>	Foothills	28.4	27.4	None
<b>Calcium</b>	Moffat	8.2	10.8	None

## Denver Water Average Values for 2003

<b>Parameter</b>	<b>Treatment Plant</b>	<b>Raw Water Result</b>	<b>Treated Water Result</b>
<b>Magnesium</b>	Marston	7.6	7.5
<b>Magnesium</b>	Foothills	6.3	6.0
<b>Magnesium</b>	Moffat	2.0	2.0
<b>Potassium</b>	Marston	2.4	2.5
<b>Potassium</b>	Foothills	2.2	2.1
<b>Potassium</b>	Moffat	0.8	0.7
<b>Sodium</b>	Marston	17.0	22.6
<b>Sodium</b>	Foothills	13.5	18.2
<b>Sodium</b>	Moffat	2.8	6.9

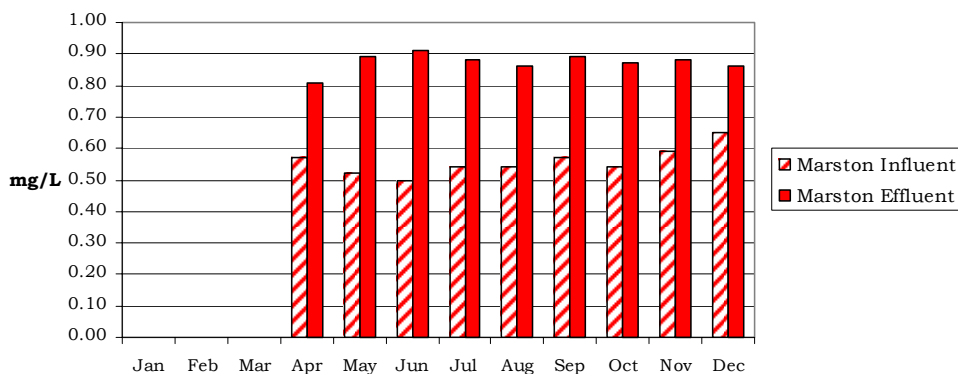
Most minerals are not removed by conventional treatment. Calcium, magnesium, iron and manganese amounts may be reduced by water treatment, but not completely removed. Please note that the comparisons above, though from the same treatment plants are not always from samples collected on the same dates for the raw and the finished waters, and therefore, are general comparisons. Drinking water naturally contains several minerals that are in fact beneficial to humans and mammals. The minerals in both of the tables above, are beneficial at prescribed levels. However, at levels above the regulatory limits (where applicable) some of these minerals may cause detrimental effects over a lifetime.

If there is no regulatory limit, or MCL listed in the above tables, then the amount of the mineral that might cause a potential health concern is much higher than would ever be found in water. It would be a waste of time and resources to regulate it.

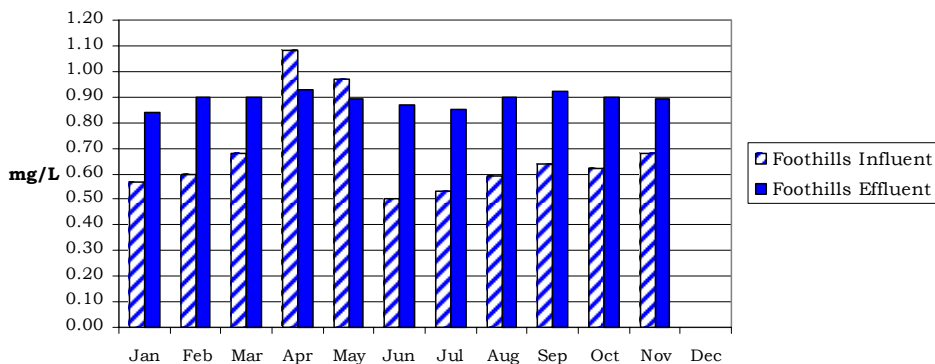
## Comparison of Fluoride Between Raw And Treated Water

Fluoride is a naturally occurring substance. 0.90 mg/L is considered ideal for helping to prevent tooth decay as determined by the American Dental Association. The Moffat source has lower amounts of fluoride and therefore must be fortified at the treatment plant up to the recommended 0.90 mg/L. All of our treatment plants can supplement fluoride.

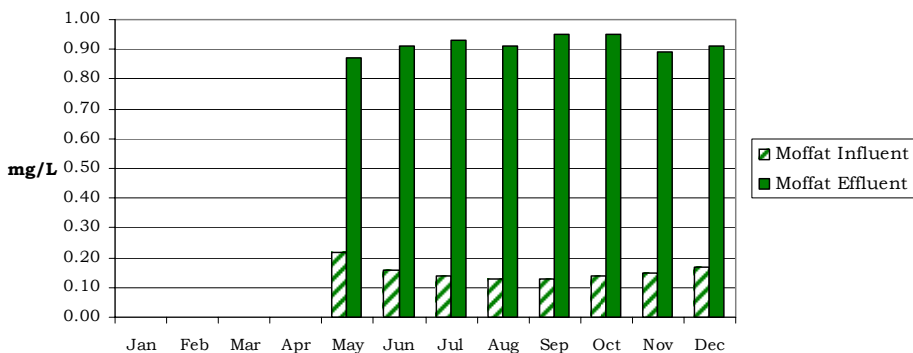
**Monthly Average Fluorides  
Marston Treatment Plant for 2003**



**Monthly Average Fluorides  
Foothills Treatment Plant for 2003**



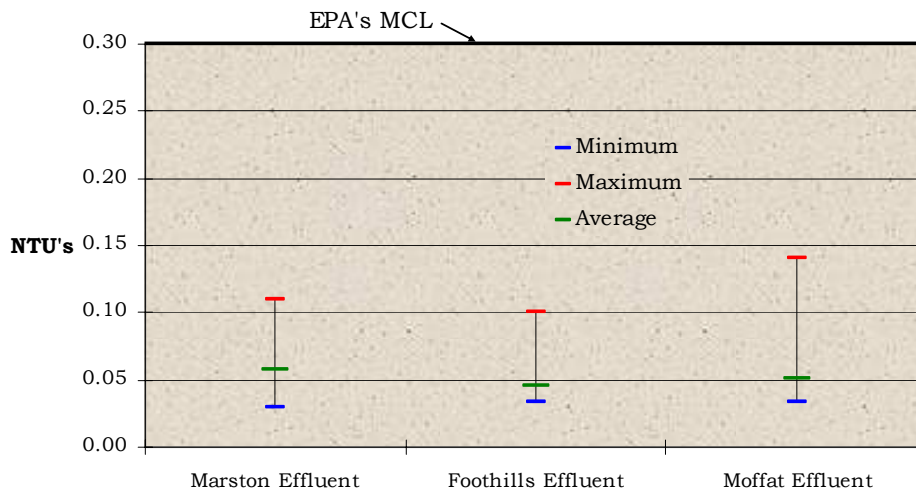
**Monthly Average Fluorides  
Moffat Treatment Plant for 2003**



## Turbidity and Hardness Graphs

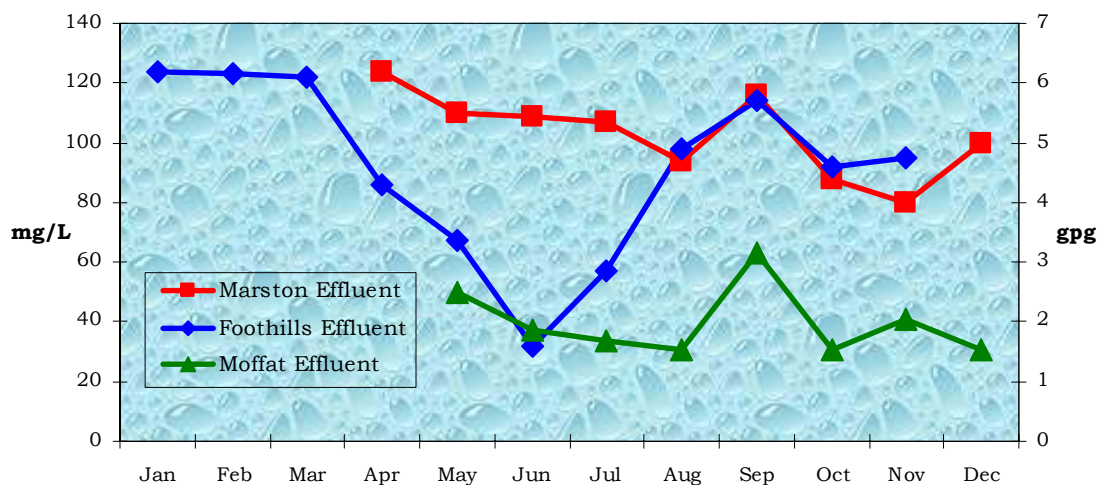
Turbidity refers to the clarity of the water. EPA has established a MCL for turbidity where at least 95% of the samples must be less than or equal to 0.30 Nephelometric Turbidity Units (NTU's) in the treatment plant effluents.

**Turbidity Ranges for Treatment Plant Effluents for 2003**



Water hardness is a result of calcium and magnesium salts dissolved in water. High concentrations of these minerals make water "hard". There is no universal hardness scale for water. Generally, water hardness as Calcium Carbonate of less than 12 grains per gallon (gpg) is not considered hard. The South Platte source water is moderately hard, and varies seasonally between 4 to 7 gpg of hardness, while the Moffat source is soft, and varies seasonally between 1 to 4 gpg. Most customers calling about hardness are inquiring for detergent usage amounts, or adding tap water to their irons or humidifiers.

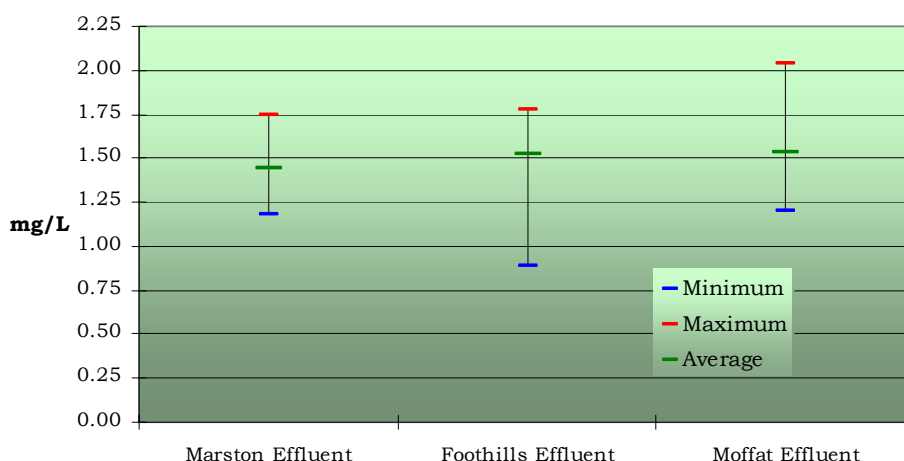
**Monthly Hardness for Treatment Plant Effluents for 2003**



## Chlorine and Temperature Graphs

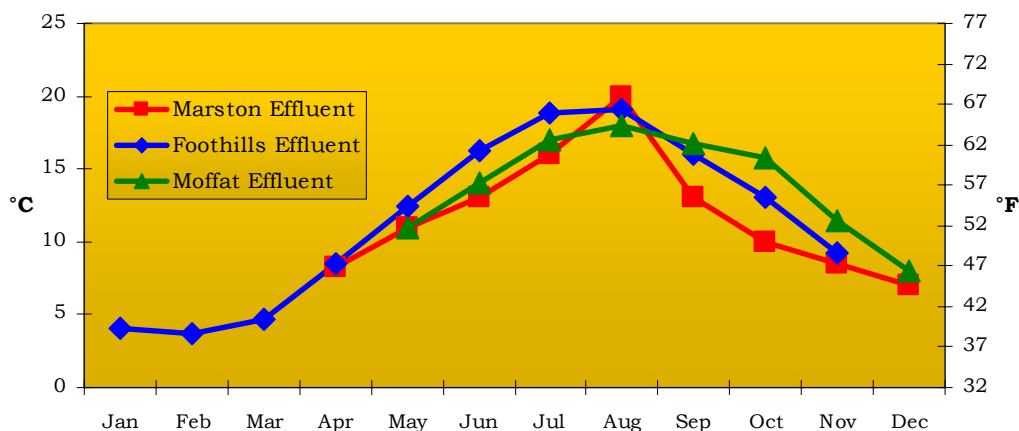
Denver Water uses chloramine to disinfect the water. The upper limit for chloramine is 4 mg/L and the lower limit is 0.20 mg/L. In the graph below chloramine is measured as total chlorine. During the late summer into the fall, the chloramine dosage is usually increased to minimize bacterial re-growth in the system. Generally, the goal for chloramine dosage is to achieve a residual of  $1.3 \pm 0.2$  mg/L

**Chlorine Ranges for Treatment Plant Effluents for 2003**



The water temperatures leaving the treatment plants fluctuate seasonally influenced by the temperatures of the flows from the mountain runoff, very cold in the winter and warmer in the summer. At higher temperatures, the disinfectant is more likely to dissipate allowing for bacterial re-growth. Chloramine residuals can be increased during the summer to ensure thorough disinfection. Breaks in the lines of the graphs indicate periods when the plants were not in service.

**Average Monthly Temperatures of Treatment Plant Effluents for 2003**



## Terms And Explanations

The tables on the next pages show the results for the treatment plant effluent water tests. Either Denver Water's Water Quality Laboratory, or a contract laboratory performed these analyses during 2003.

Pages 18 through 23 are tables of data for compounds detected in our three treatment plant effluent waters. The tables contain the name of the compound, the range of detections for the year, the average result and the number of times for which it was tested. Most of the compounds detected are not regulated and do not pose a health or safety risk.

Compounds that were not detected in Denver's water are listed on the opposite page. We test for all of these compounds and contaminants at least annually. Contaminants that have been in the news recently, such as arsenic, lead, and radon are on the list. Some of the abbreviations next to the contaminant on the next page are explained below.

AL—Action Levels are enforceable triggers for compliance that force public notification and treatment optimization.

MCL—Maximum Contaminant Level, the U.S. Environmental Protection Agency's (EPA's) drinking water regulatory limits. Based on health and toxicology studies, results at or below these levels in drinking water are considered safe. These are usually numeric values; sometimes they are designated as DS or TT (see below)

SMCL—Secondary Maximum Contaminant, the U.S. Environmental Protection Agency's non-enforceable, but recommended guideline level of a contaminant or compound. The exception to the rule is the fluoride SMCL of 2 mg/L that when exceeded triggers public notification.

DS—Distribution System is how the total coliform regulation is decreed. This means that the total coliform regulation (less than 5% total coliform positive samples per month) applies to the water in the distribution system (city) not just the treatment plant effluents.

TT—Treatment Technique, is used for example for the Lead and Copper Rule. The water treatment process used in the treatment plants must be optimized to control the levels of these parameters, such as corrosion control. The Lead and Copper Rule, specifically requires testing in a specified number of EPA defined "high risk" homes. EPA has defined "high risk" homes as older homes with lead plumbing or lead services and newer homes with copper pipe and lead based solder, built between 1982 and 1987. Lead solder was banned from domestic plumbing use in 1988. Homes built between the older ones and 1982 should have sufficient scale formation on the pipe walls to prevent contact with the plumbing thereby eliminating the possibility of lead from the plumbing leaching into the water. We not only test in these customer homes, but we also test the raw water, treated water and distribution system water for lead and copper. We have not detected lead in the raw, treated or distribution system water, and only small amounts of copper (less than a tenth of the regulatory limit) have been found.

## Not Found In Denver's Drinking Water

Denver's water was analyzed for the following parameters. They were either not detected or the average result was less than the detection limits. The MCL is listed after the component in parenthesis where applicable. The unit of measure is also listed if different than that listed for the subsection. These potential contaminants are on EPA's nation-wide list of regulatory concerns.

### General

Chlorine, Free  
**Metals** (mg/L)  
 Antimony (0.006)  
 Arsenic (0.05)  
 Beryllium (0.004)  
 Cadmium (0.005)  
 Chromium (0.1)  
 Cobalt  
 Iron  
 Lead (TT<sup>1</sup>)  
 Lithium  
 Mercury, Total (0.002)  
 Nickel (0.1)  
 Selenium (0.05)  
 Silver  
 Thallium (0.002)  
 Titanium  
 Vanadium  
**Ions** (mg/L)  
 Ammonia-Nitrogen  
 Bromide  
 Cyanide, Total (0.2)  
 Nitrite-Nitrogen (1)  
 Ortho Phosphorus, Dissolved  
 Perchlorate

### Radiological (pCi/L)

Alpha, Total (15)  
 Plutonium 239 + 240  
 Radium-226, 228  
 Radon 222  
 Strontium 89 + 90

### Microbiological

*Cryptosporidium*  
*Giardia* (TT<sup>1</sup>)  
 Plankton  
 Total Coliform (DS)

### Volatile Organic Compounds (µg/L)

1,1,1,2-Tetrachloroethane  
 1,1,1-Trichloroethane (200)  
 1,1,2,2-Tetrachloroethane  
 1,1,2-Trichloroethane (5)  
 1,1-Dichloroethene (7)  
 1,1-Dichloropropene  
 1,2,3-Trichloropropane  
 1,2,4-Trichlorobenzene (70)  
 1,2,4-Trimethylbenzene  
 1,2-Dichloroethane (5)  
 1,2-Dichloropropane (5)  
 1,3,5-Trimethylbenzene  
 1,3-Dichloropropane  
 2,2-Dichloropropane  
 2-Butanone  
 4-Methyl-2-Pentanone  
 Benzene (5)  
 Bromobenzene  
 Bromochloromethane  
 Bromomethane  
 Chlorobenzene (100)  
 Chloroethane  
 Chloromethane  
 cis-1,2-Dichloroethene (70)  
 cis-1,3-Dichloropropene  
 Dibromomethane  
 Dichlorodifluoromethane  
 Dichloromethane (5)  
 Ethyl Benzene (700)  
 Hexachlorobutadiene  
 Isopropyl Benzene  
 m-Dichlorobenzene  
 Methyl tert-butylether  
 Naphthalene  
 n-Butyl Benzene  
 Nitrobenzene  
 n-Propyl Benzene

o-Chlorotoluene  
 o-Dichlorobenzene (600)  
 p-Chlorotoluene  
 p-Dichlorobenzene (78.5)  
 p-Isopropyl Toluene  
 sec-Butyl Benzene  
 Styrene (100)  
 tert-Butyl Benzene  
 Tetrachloroethene (5)  
 Toluene (1000)  
 trans-1,2-Dichloroethene (100)  
 trans-1,3-Dichloropropene  
 Trichloroethylene (5)  
 Trichlorofluoromethane  
 Vinyl Chloride (2)  
 Xylenes (10000)

### Disinfection By-Products (µg/L)

Carbon tetrachloride (5)  
 Chlorodibromoacetic acid  
 Chloropicrin  
 Dibromoacetone  
 Monobromoacetic Acid  
 Monochloroacetic Acid  
 N-nitrosodimethylamine  
 Trichloroacetone

### Pesticides (µg/L)

1,2-Dibromo-3-chloropropane (0.2)  
 2,4,5-T  
 2,4-D (70)  
 2,4-DB  
 3,5-Dichlorobenzoic acid  
 3-Hydroxycarbofuran  
 4,4'-DDD  
 4,4'-DDE  
 4,4'-DDT  
 α-BHC  
 Acetochlor  
 Acifluorfen  
 Alachlor (2)  
 Aldicarb  
 Aldicarb sulfoxide  
 Aldrin  
 Atrazine (3)  
 β-BHC  
 Bentazon  
 Bromacil  
 Butachlor  
 Carbaryl  
 Carbofuran (40)  
 Chlordane (2)  
 Chlornel  
 Chlorobenzilate  
 Chlorothalonil  
 Dalapon (200)  
 δ-BHC  
 Diazinon  
 Dicamba  
 Dichlorprop  
 Dichlorvos  
 Dieldrin  
 Dimethoate  
 Dinoseb (7)  
 Diquat (100)  
 Disulfoton  
 Diuron  
 Dursban  
 Endothall (100)  
 Endrin (2)  
 Endrin Aldehyde  
 EPTC  
 Ethylene dibromide (0.05)  
 Fonofos  
 Glyphosate (700)  
 Heptachlor (0.4)  
 Heptachlor Epoxide (0.2)

Hexachlorocyclopentadiene (50)  
 Lindane (0.2)  
 Linuron  
 Malathion  
 Methiocarb  
 Methomyl  
 Methoxychlor (40)  
 Metolachlor  
 Metribuzin  
 Molinate  
 Oxamyl (200)

Paraquat  
 Parathion  
 Picloram (500)  
 Prometon  
 Prometryn  
 Propachlor  
 Propoxur  
 Silvex (50)  
 Simazine (4)  
 Terbacil  
 Terbufos  
 Thiobencarb  
 Total Dacthal Acid degradates  
 Toxaphene (3)  
 Trifluralin

### Synthetic Organic Compounds (µg/L)

1,2-Diphenylhydrazine  
 2,4-Dichlorophenol  
 2,4-Dinitrophenol  
 2,4-Dinitrotoluene  
 2,4,6-Trichlorophenol  
 2,6-Dinitrotoluene  
 2-Methylphenol  
 Acenaphthylene  
 Anthracene  
 Benzo(a)anthracene  
 Benzo(a)pyrene (0.2)  
 Benzo(b)fluoranthene  
 Benzo(g,h,i)perylene  
 Benzo(k)fluoranthene  
 Bis(2-ethylhexyl)adipate (400)  
 Bis(2-ethylhexyl)phthalate  
 Butyl benzyl phthalate  
 Chrysene  
 Dibenzo(a,h)anthracene  
 Diethyl phthalate  
 Dimethyl phthalate  
 Di-n-butyl phthalate  
 Di-n-octyl phthalate  
 Fluoranthene  
 Fluorene  
 Hexachlorobenzene (1)  
 Indeno(1,2,3-cd)pyrene  
 Isophorone  
 Pentachlorobenzene  
 Pentachlorophenol (1)  
 Phenanthrene  
 Polychlorinated Biphenyls (0.5)  
 Pyrene

## Data Tables For Treatment Plant Effluents

### Marston Treatment Plant Effluent

Analysis	MCL	Avg.	Range	No.
<i>General (mg/L)</i>				
Alkalinity, Total as CaCO <sub>3</sub>		52.6	42 - 85	550
Chlorine, Total		1.44	1.18 - 1.75	3,300
Hardness as CaCO <sub>3</sub>		105	80 - 124	12
pH (SU)		7.69	7.30 - 8.30	3,300
Specific Conductance (uS/cm)		328	210 - 420	183
Temperature (°C)		12	5 - 22	185
Total Dissolved Solids		197	165 - 223	9
Turbidity (NTU)	TT	0.06	0.03 - 0.11	3,284
<i>Metals (mg/L)</i>				
Aluminum, Total		0.025	<0.020 - 0.048	9
Barium, Total	2	0.044	0.038 - 0.050	9
Calcium		32.0	29.5 - 37.6	9
Copper, Total	TT	<0.006	<0.006 - 0.012	9
Magnesium		7.5	5.4 - 9.2	9
Manganese, Total		0.007	<0.006 - 0.016	9
Molybdenum, Total		0.025	0.012 - 0.045	9
Potassium		2.5	2.3 - 2.8	9
Sodium		22.6	13.3 - 31.0	10
Zinc, Total		<0.003	<0.003 - 0.005	9
<i>Ions (mg/L)</i>				
Chloride		27.9	14.0 - 34.4	9
Fluoride	4	0.88	0.48 - 1.24	1,116
Nitrate-Nitrogen	10	0.26	0.07 - 0.41	9
Silicon		1.9	0.89 - 2.6	9
Sulfate		60.4	53.6 - 70.3	9

## Marston Treatment Plant Effluent

Analysis	MCL	Avg.	Range	No.
<i>Radiological</i>				
Beta, Total (pCi/L)	50 <sup>(4mRem/yr)</sup>	2.8	2.0 - 4.1	3
<i>Microbiological</i>				
m-Heterotrophic Plate Count (CFU/ml)		4.6	0.04 - 38	38
<i>Disinfection By-Products (µg/L)</i>				
1,1,1-Trichloropropanone		1.5	1.4 - 1.7	9
1,1-Dichloropropanone		1.1	0.9 - 1.3	3
Bromochloroacetic acid		1.4	<0.5 - 2.8	7
Bromochloroacetonitrile		0.4	<0.2 - 0.8	3
Bromodichloroacetic acid		3	<1 - 7	8
Bromodichloromethane		6.9	4.2 - 8.2	17
Chloral hydrate		1.4	0.5 - 2.1	8
Chloroform		10.5	5.4 - 15.0	17
Chloropicrin		<0.4	<0.4 - 0.5	3
Cyanogen Chloride		6.3	n/a	1
Dibromochloromethane		2.5	0.9 - 4.2	17
Dichloroacetic acid		6.3	3.5 - 13.2	9
Dichloroacetonitrile		1.4	1.3 - 1.5	3
Haloacetic Acids (5)	60	12	7 - 20	9
Total Trihalomethanes	80	20	12 - 26	17
Trichloroacetic acid		5.2	2.0 - 7.5	9
<i>Non-Specific Organic Compounds (mg/L)</i>				
Total Organic Carbon	TT	2.1	1.0 - 2.9	39
Total Organic Halogen		167	n/a	1

## Foothills Treatment Plant Effluent

Analysis	MCL	Avg.	Range	No.
<i>General (mg/L)</i>				
Alkalinity, Total as CaCO <sub>3</sub>		52.6	24 - 82	672
Chloramine, Total		1.52	0.89 - 1.78	4,032
Hardness as CaCO <sub>3</sub>		89	32 - 124	14
pH (SU)		7.83	7.42 - 8.55	4,032
Specific Conductance (uS/cm)		292	140 - 430	221
Temperature (°C)		12	1 - 20	222
Total Dissolved Solids		175	101 - 226	11
Turbidity (NTU)	TT	0.046	0.034 - 0.10	4,107
<i>Metals (mg/L)</i>				
Aluminum, Total		0.064	0.020 - 0.180	12
Barium, Total	2	0.043	0.030 - 0.053	12
Calcium		27.4	12.4 - 37.6	12
Copper, Total	TT	<0.006	<0.006 - 0.008	12
Magnesium, Total		6.0	2.8 - 8.9	12
Manganese, Total		<0.006	<0.006 - 0.016	12
Molybdenum, Total		0.027	<0.003 - 0.051	12
Potassium		2.1	1.2 - 2.6	12
Sodium		18.2	14.0 - 25.5	13
Zinc, Total		<0.003	<0.003 - 0.005	12
<i>Ions (mg/L)</i>				
Chloride		21.3	11.1 - 33.6	11
Fluoride	4	0.89	0.45 - 1.77	2,018
Nitrate-Nitrogen	10	0.20	0.09 - 0.47	11
Silicon		2.8	1.1 - 5.6	11
Sulfate		56.8	32.6 - 75.3	11

## Foothills Treatment Plant Effluent

Analysis	MCL	Avg.	Range	No.
<i>Radiological</i>				
Beta, Total (pCi/L)	50 <sup>(4mRem/yr)</sup>	<2	<2 - 2.8	4
<i>Microbiological</i>				
m-Heterotrophic Plate Count (CFU/ml)		0.88	<0.01 - 6.1	40
<i>Disinfection By-Products (µg/L)</i>				
1,1,1-Trichloropropanone		1.7	1.0 - 2.4	4
1,1-Dichloropropanone		0.8	0.6 - 1.2	4
Bromochloroacetic acid		1.6	<0.5 - 3.4	9
Bromochloroacetonitrile		0.4	0.4 - 0.5	4
Bromodichloroacetic acid		4	<1 - 12	10
Bromodichloromethane		8	4 - 13	20
Chloral hydrate		3.0	0.8 - 6.4	10
Chlorodibromoacetic acid		2	<2 - 7	6
Chloroform		29.3	8.2 - 57.0	20
Chloropicrin		0.6	<0.4 - 1.0	4
Cyanogen Chloride		18	n/a	1
Dibromoacetic acid		0.5	<0.5 - 2.9	11
Dibromochloromethane		1.1	<0.5 - 2.3	20
Dichloroacetic acid		12.2	4.8 - 20.4	11
Dichloroacetonitrile		2.6	1.8 - 3.1	4
Haloacetic Acids (5)	60	27	13 - 46	11
Total Trihalomethanes	80	39	16 - 61	20
Trichloroacetic acid		14.6	5.8 - 26.7	11
<i>Non-Specific Organic Compounds (mg/L)</i>				
Total Organic Carbon	TT	1.7	0.9 - 3.0	42
Total Organic Halogen		234	n/a	1

## Moffat Treatment Plant Effluent

Analysis	MCL	Avg.	Range	No.
<i>General (mg/L)</i>				
Alkalinity, Total as CaCO <sub>3</sub>		21	16 - 46	538
Chloramine, Total		1.53	1.20 - 2.04	3,228
Hardness as CaCO <sub>3</sub>		34	26 - 54	9
pH (SU)		7.82	6.72 - 9.07	3,228
Specific Conductance (uS/cm)		110	70 - 240	173
Temperature (°C)		14	5 - 18	176
Total Dissolved Solids		68	55 - 91	8
Turbidity (NTU)	TT	0.05	0.03 - 0.14	3,187
<i>Metals (mg/L)</i>				
Aluminum, Total		<0.02	<0.02 - <0.02	8
Barium, Total	2	0.018	0.015 - 0.024	8
Calcium		10.8	9.3 - 14.5	8
Copper, Total	TT	<0.006	<0.006 - 0.007	8
Magnesium, Total		2.0	1.5 - 3.1	8
Manganese, Total		<0.006	<0.006 - <0.006	8
Potassium		0.7	0.6 - 1.0	8
Sodium		6.9	5.5 - 8.4	8
Zinc, Total		<0.003	<0.003 - 0.003	8
<i>Ions (mg/L)</i>				
Chloride		4.6	3.2 - 7.4	8
Fluoride	4	0.91	0.21 - 1.37	1,565
Nitrate-Nitrogen	10	0.11	0.07 - 0.24	8
Silicon		3.2	2.8 - 3.5	8
Sulfate		19.3	16.1 - 26.7	8

## Moffat Treatment Plant Effluent

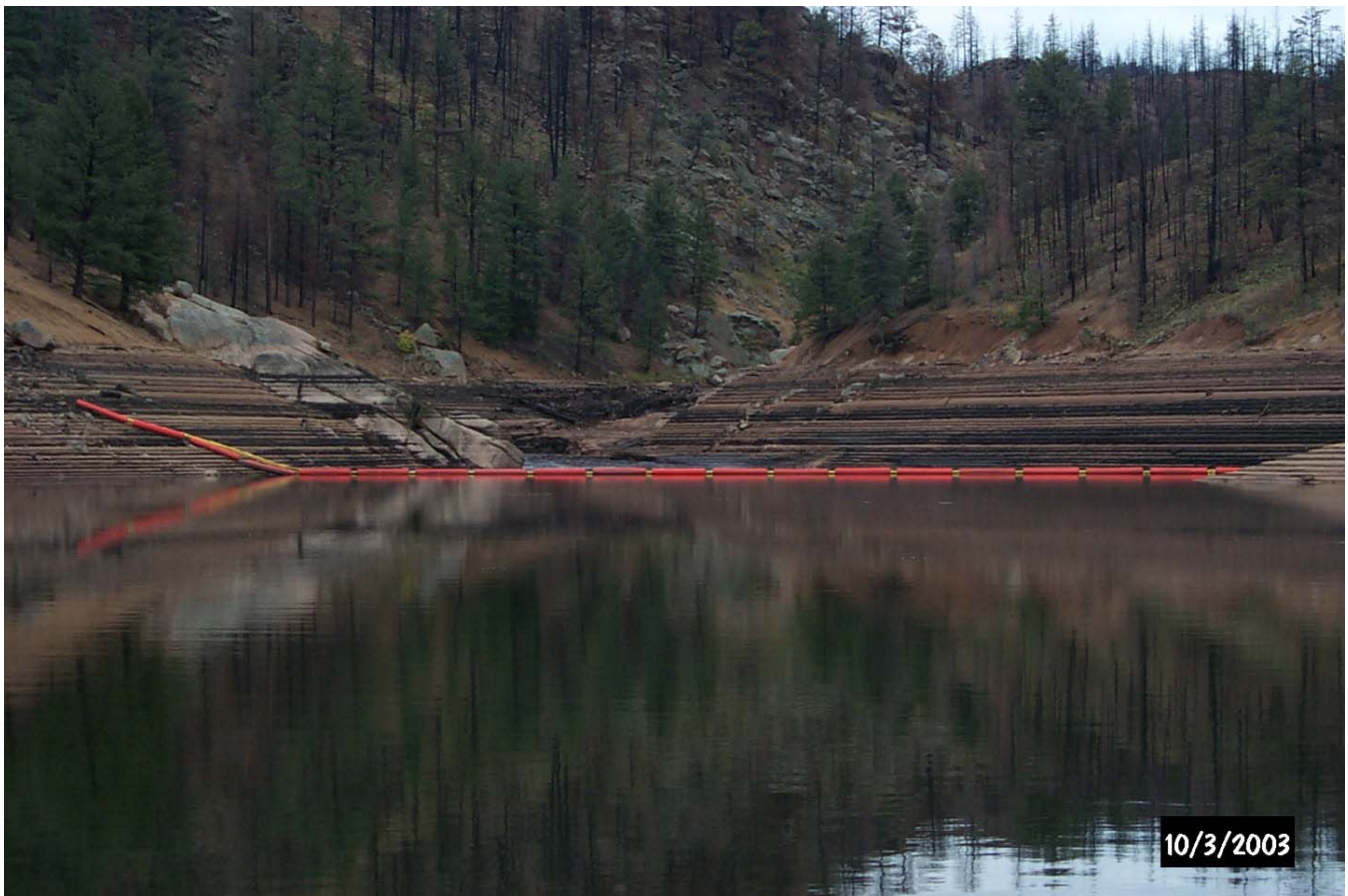
Analysis	MCL	Avg.	Range	No.
<i>Radiological</i>				
Beta, Total (pCi/L)	50 <sup>(4mRem/yr)</sup>	2.5	<2 - 4	2
<i>Microbiological</i>				
m-Heterotrophic Plate Count (CFU/ml)		2.0	0.04 - 11	36
<i>Disinfection By-Products (µg/L)</i>				
1,1,1-Trichloropropanone		1.2	1.0 - 1.3	3
1,1-Dichloropropanone		0.6	0.5 - 0.6	3
Bromochloroacetic acid		<1	<1 - 1	7
Bromochloroacetonitrile		<0.2	<0.2 - <0.2	3
Bromodichloroacetic acid		<1	<1 - 1	7
Bromodichloromethane		1.7	0.8 - 3.3	15
Chloral hydrate		1.2	0.8 - 1.9	7
Chlorodibromoacetic acid		<2	<2 - <2	5
Chloroform		14.0	9.3 - 17.0	15
Cyanogen Chloride		6.5	n/a	1
Dibromochloromethane		<0.5	<0.1 - <0.5	15
Dichloroacetic acid		7.9	4.4 - 9.6	8
Dichloroacetonitrile		1.3	1.3 - 1.4	3
Haloacetic Acids (5)	60	15	10 - 18	8
Total Trihalomethanes	80	15	12 - 18	15
Trichloroacetic acid		6.8	5.0 - 8.7	8
<i>Non-Specific Organic Compounds (mg/L)</i>				
Total Organic Carbon	TT	1.3	0.7 - 2.3	36
Total Organic Halogen		143	n/a	1

## Looking Down The Road

What does the future hold in terms of water treatment and drinking water? As with other utilities around the country, Denver Water is updating its treatment plants and exploring new treatments and techniques to optimize treatment in preparation for upcoming regulations and greater protection from contaminants in the future.

In this effort we are studying the effectiveness and feasibility of using ultra-violet (UV) light for supplemental disinfection. Many utilities across the country are also exploring UV disinfection as a viable alternative or supplemental treatment. Additionally, Denver Water is upgrading its Process Control software in 2004.

The picture below shows the remediation effort to prevent debris from spoiling Cheesman Reservoir. The red and yellow booms have greatly aided in minimizing debris from run off into the reservoir.



Report prepared by:  
Maria Rose, Denver Water  
Water Quality Laboratory

We will continue to remain vigilant for impacts and effects of the low water levels on our drinking water treatment and system. It is important to note that we have had below average snow falls in the mountains for going on six years now, and it will most likely take a minimum of three years of average mountain snow fall/runoff for our system to recuperate. Below is a picture of Antero Reservoir, see the map on page 6. Antero was drained in late 2002 to fill Eleven Mile Reservoir.



Many new challenges await us in the drinking water industry. We are our own customers; therefore, we have a stake in making sure that the water is safe for all of us. We are also environmental scientists and we care about the preservation of our watershed and the natural beauty that surrounds it. Though we have caretakers who live near our mountain reservoirs and monitor them, customers help with this effort and we appreciate it. We are committed to meeting your water needs by continuing to provide high quality drinking water and excellent service. If you have a water quality concern or just have questions, or comments regarding water quality, give us a call at 303-893-2444.

Denver Water's 2003 Treated Water Quality Summary Report

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